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The American Association for the Advancement of Science:
Taxonomy as a Field for Research: DR. J. M. GREENMAN 265

Americans and the Royal Society: DR. R. HEATHCOTE HEINDEL 267

Scientific Events:
Liverpool Cancer Commission of Inquiry; Investigation of the Pilchard Fishery; The Floods in Southern California; The Seventh Hancock Pacific Expedition. Recent Deaths 272

Scientific Notes and News 275

Discussion:
Science at the University of Chicago: PROFESSOR CARL R. MOORE. *Effects of Freezes in Southern California on Shade and Ornamental Trees:* S. A. SKINNER. *"Idest":* G. R. L. POTTER. *The Manufacture of Kraft Pulp and Paper:* DR. CHAS. H. HERTY 278

Reports:
Progress of the New York Zoological Society: FAIRFIELD OSBORN 280

Special Articles:
The X Particle: DR. ARTHUR BRAMLEY. *Administration of Oestrone to Young Alligators:* DR. THOMAS R. FORBES. *The Flagellation of Bacteria:* DR. H. J. CONN and GLADYS E. WOLFE. *The Molecular Weight of Crystalline Catalase:* PROFESSOR JAMES B. SUMNER and DR. NILS GRALÉN 281

Science News 8

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TAXONOMY AS A FIELD FOR RESEARCH[1]

By Dr. J. M. GREENMAN

MISSOURI BOTANICAL GARDEN

IT has been customary for the retiring vice-president of Section G of the American Association for the Advancement of Science to present at the expiration of his term of office a retiring address. I shall adhere to that established custom. However, realizing that we have a very full program ahead of us, and that an important symposium is to follow this address, I shall be very brief. Knowing also, that it would be expected of me to deal with some phase of taxonomy, I have chosen for my subject "Taxonomy as a Field for Research." I have done this with some degree of hesitation, but with the profound conviction that taxonomy furnishes a fertile field for the apt student, that it has much to contribute to related sciences and therefore merits a place along with other botanical subjects in the domain of pure research.

That taxonomy has made marked advances during the past three or four decades, I think few would be inclined to question. Interest in this subject in recent years has been stimulated in many ways, particularly by numerous scientific expeditions, which have been concerned either wholly with botany or in which botany has taken an important place. The results of these expeditions to various and little known parts of the world have greatly added to our knowledge of the world's flora. Extensive collections of plants from hitherto little-known regions have furnished material for floristic studies on which new floras have been based, and they have also furnished material for monographic research.

New methods of attack have been brought to bear

[1] Address of the vice-president and chairman of the section on the Botanical Sciences, American Association for the Advancement of Science, Indianapolis, December 28, 1937.

on taxonomic problems, such as studies in comparative embryology, life histories, detailed anatomical studies, particularly in floral anatomy, and cyto-genetic researches—all revealing hitherto unrecorded characters and presenting convincing evidence of genetic relationship and phylogeny. Many of these considerations are reflected in much of the literature of to-day, and all are destined to play an important part in the systematics of the future. I do not mean that a new taxonomy has developed, but merely that a more intensive and comprehensive taxonomy is being pursued. The fundamental basis of taxonomy always has been and always will be comparative morphology.

There has been in recent years an increasing demand on the part of advanced students for more training in taxonomy and for opportunities to carry on research in this field. It is of interest to note how our educational institutions, particularly our universities, through the graduate schools, have responded to this growing importance of taxonomy in its broader aspect. Additional courses in taxonomy and in cognate subjects have been established, and opportunities for taxonomic research have been provided. Thus, it has become possible for the individual, interested in systematics, to major in this subject and to carry forward his main interests until qualified to pursue a life work either in teaching or in research or in a position combining both teaching and research.

Furthermore, there has been during the last three or four decades, except during the period of greatest depression, or recession, an increasing demand from universities, colleges and research institutions for the trained taxonomist. I mean by trained taxonomist the individual who has had a broad fundamental training in the general field of botany, supplemented by a practical experience in an intensive and comprehensive study of a carefully selected genus consisting of a limited number of species. Such a training gives the student a mastery of evaluation of characters involved in relation to a taxonomic treatment and, furthermore, enables him to pursue independently a research problem in taxonomy or to conduct work in taxonomic research.

While I have the most profound respect for careful floristic studies, and I fully realize their importance, yet floristic studies alone in my judgment do not give the essential background and experience for the complete evaluation of the factors concerned in terms of taxonomy.

Profitable research in taxonomy presupposes then a broad foundation in general botany, and aptitude on the part of the individual, as well as adequate library and herbarium facilities, and also opportunity for experimental work and field studies. I do not mean that a library must be absolutely complete in the field of taxonomic literature, nor do I mean that every known species must be represented in the herbarium. Such completeness does not now exist and in all probability never will exist anywhere. But, excellent library and herbarium facilities for pursuing research work in taxonomy do exist at several institutions in this country; and these conditions are constantly being improved. In addition thereto, however, a study of living plants under cultivation, as well as a study of plants in the field in their natural habitats are important adjuncts to the proper understanding of every group of plants constituting a problem of taxonomic research.

I have pointed out the general trend of taxonomic study during recent years; but there is one more matter which I would like to mention, and that is an international spirit of cooperation in science. I refer particularly to the willingness and desire on the part of foreign botanists to cooperate with Americans in the field of taxonomic research. It is no longer an uncommon occurrence to receive from European and South American institutions relatively large collections of plants, loans of types, copies of descriptions and of illustrations of rare publications, without which it would be impossible to proceed satisfactorily with monographic studies. Thirty years ago it would have been considered impracticable to send over seas old, scientifically valuable and irreplaceable material for fear of loss in transit.

I might cite numerous instances where relatively large and historically important collections have been sent on loan from the great scientific centers of Europe to institutions in the United States for study by experienced taxonomists and monographers. Furthermore, American students are always welcome to visit the great European herbaria and to make free use of their facilities.

Summary: I have tried to point out as briefly as possible some of the main lines along which taxonomy has advanced during the past three or four decades and to indicate some of the new methods of attacking certain problems in taxonomy. I have tried, moreover, to show that there has been an increasing demand on the part of advanced students for better facilities to obtain the necessary training in this field. I have shown also how educational institutions are meeting this demand. It is significant, moreover, that meanwhile there has been an increasing demand from universities, colleges and other institutions for the individual trained in taxonomy.

All things considered, I believe that taxonomy as a field for research offers greater opportunities than ever before for advancing our knowledge of plants and their classification.

AMERICANS AND THE ROYAL SOCIETY 1783-1937

By R. HEATHCOTE HEINDEL
UNIVERSITY OF PENNSYLVANIA

As one approach to the study of the scientific relations between Great Britain and the United States, even for those who would affirm that all science is international, the proposals or the elections of American scientists as foreign members or as medalists of the Royal Society contain much of interest.[1] Not until similar lists are drawn up of American membership in other foreign learned societies, keeping in mind the changing value of such membership because of the varied careers of various societies, can historical reflection be freely indulged; but so important has been any recognition by the Royal Society that we may be content for the moment to confine attention to it.

After the American Revolution, James Bowdoin in 1788 was the first "foreign" American member. The long period of non-recognition lies between the years 1818 and 1852, the date of Nathaniel Bowditch's election and the selection of Benjamin Peirce. Louis Agassiz, elected in 1838, could scarcely have been considered to draw attention to America until some years after his emigration to that country in 1845. And by a chance, Audubon was elected as a home member in 1830, although it is more true to say that it was because of the work he was carrying on in the States.

The progressive increase of American membership (see Table I) is obvious after 1918. Further than that, speculation over the dates may be left to the reader. But it is undoubtedly true that such events as the meeting of the British Association in Canada in 1884 brought the British into personal touch with activities below the border, and personal visits of men like Sir Joseph Hooker and Huxley at other times served to facilitate the recognition of American science. It will be noted that members of the British Empire, particularly Canadians, frequently acted as conductors. I hazard one query: did France follow more closely American developments in science?

The learned societies of the two countries were especially interested in uniting efforts for a systematic meteorological inquiry in North America, and American resolutions were forthcoming urging the continuance of the Toronto observatory.[2] Part of the penetration by America depended upon the interchange of her scientific literature with Great Britain. Considerable correspondence, especially with the Smithsonian Institution, was concerned in maintaining and extending the duty-free list.[3] In an office letter, W. White wrote to General Sabine on December 28, 1860:[4]

> With respect to the difficulties which have hitherto prevailed in the distribution of the consignments of books to this country, they are owing to no fault on this side of the water.

The Smithsonian had begun to send books to individuals and organizations not on the list drawn up by the Royal Society as receiving duty-free books from abroad. Mr. White continues:

> Among the places and establishments embraced in this enlarged scheme of distribution, are Lunatic Asylums, Provincial Libraries, Mechanic's Institutes, Consular Offices, various Clubs, Lloyds, the Custom House, the Foreign Office, Military Academy, Harbour Offices, Town Clerks' Offices, Boards of Health, Schools of Arts, Railway Stations, Blind Schools, and sundry bookselling firms, and among Individuals are, the Editor of the *Times*, Editors of various Periodicals and Reviews, and many persons unknown to the R.S. In one consignment there was sent a bundle of a religious pamphlet for distribution which could hardly come within the definition of scientific books.

This democratic extension delayed those consignments which could go legitimately upon the free list.

Naturally the Smithsonian had attracted attention. Edward Sabine, then foreign secretary of the Royal Society, wrote from Woolwich, October 19, 1849,[5]

> that an official letter will follow, But I take, in the mean time, the earliest opportunity of informing you that the Council of the Royal Society have had great pleasure in complying with the request made to them to place the

[1] The material for this article has been drawn mostly from the Royal Society Library, Burlington House, London. The society's official correspondence for the nineteenth century does not have much relevance, although a survey of it shows that a few contacts were maintained. Cataloguing of the mss. continues by the staff, hence, exact references are not made. The Bache and Henry letters are to be found in the Edward Sabine collection, as yet, uncatalogued. Proceedings of the Royal Society, Vol. xi, Lond. 1862; vol. xxvi, Lond. 1878. Minutes of Council, Royal Society, 4 vols., 1833–1877; Index of Council Books (mss.) vols. 1–4. Certificates of Royal Society, 1784–1936. Mss. The Year-Book of the Royal Society, 1896–1936. See especially the volume for 1912. Royal Society Medal Claims, 1873–1936. Privately printed. Vol. 1, 1873–1909; Vol. 2, 1910–. Royal Society List of Fellows, 5 vols., 1775–1900.

[2] Royal Society Min. of Council, Vol. II, pp. 176–179, 1850. See resolution, Amer. Acad. of Arts and Science, Cambridge, 25 Nov., 1850, in official correspondence.

[3] Royal Society Min. of Council, Vol. II, pp. 196–198, 1851.

[4] Letter Book, p. 162. See also pp. 168–169.

[5] Letter Book, copy, p. 106. See also p. 107.

TABLE I

AMERICAN FELLOWS OF THE ROYAL SOCIETY, 1783–1937

Explanation:

The number of foreign members is limited to 50. Certain fellows elected as home members are marked (*). Fellows elected as home members or as foreign fellows of another country, but now in the U. S., are not included. Addresses are given at the time of election. The proposers are included in brackets. It is interesting to note that the Royal Society of Edinburgh, with its honorary foreign membership restricted to 44, has had 28 Americans on its list, counting from the year 1895.

Fellows	Date of election
Bowdoin, James, President of the American Academy (see text)	1788
Rittenhouse, David, President of the Amer. Phil. Society (see text)	1795
*Hosack, David, New York (proposed by: James Edward Smith, John Abernethy, Abraham Rees, George Parson, Gilbert Blane)	1816
Bowditch, Nathaniel, Boston (see text)	1818
*Audubon, J. J. (see text)	1830
Agassiz, Louis, Neufchatel, Copley Medal, 1861	1838
Peirce, Benjamin, Cambridge, Mass. (Edward Sabine, J. Hunter Christie, William Henry Smyth, *et al.*)	1852
Bache, Alexander Douglas, Washington (William Farr, Edward Sabine, W. A. Miller, B. C. Brodie, *et al.*)	1860
Gray, Asa, Cambridge (G. B. Airy, W. Spottiswoode, G. G. Stokes, T. H. Huxley, W. H. Miller, and J. Todhunter)	1873
Newcomb, Simon, Washington, Copley Medal, 1890	1877
*Hughes, David Edward, London	1880
Dana, James Dwight, New Haven (Joseph Prestwick and Hugo Müller). Copley Medal, 1877	1884
Rowland, Henry A., Baltimore (G. Carey Foster and W. H. Preece)	1889
Agassiz, Alexander, Cambridge, Mass. (Alfred Newton)	1891
Gould, Benjamin Apthorp, Cambridge, Mass. W. H. Christie)	1891
Newton, Hubert Anson, New Haven (Kelvin)	1892
Langley, Samuel P., Washington, Rumford Medal 1886 (1884—W. Abney; 1888—G. G. Stokes; 1895—Kelvin)	1895
Gibbs, J. Willard, New Haven, Copley Medal, 1901 (1891—Rayleigh; 1895—A. W. Rucker)	1897
Hill, George William, New York, Copley Medal, 1909 (1896—Horace Lamb and P. A. MacMahon; 1902—H. H. Turner)	1902
Michelson, Albert Abraham, Chicago, Copley Medal, 1909 (1894—Rayleigh; 1897—R. B. Clifton; 1902—W. Hicks)	1902
Pickering, Edward Charles, Cambridge (H. F. Newall)	1907
Mitchell, Silas Weir, Philadelphia (David Ferrier)	1908
Hale, George Ellery, Mount Wilson, Calif., Copley Medal, 1932 (1899—G. Johnstone Stoney; 1907—Joseph Larmor)	1909
Gilbert, Grove Karl, Washington (1915—A. Strahan)	1918
Campbell, William Wallace, Mt. Hamilton (1916—Joseph Larmor)	1918
*Matthew, William Diller, New York	1919
Flexner, Simon, New York	1919
Morgan, Thomas Hunt, New York, Darwin Medal, 1924 (1916—W. Bateson)	1919
Richards, Theodore William, Cambridge, Davy Medal, 1910 (F. G. Donnan)	1919
Wood, Robert Williams, Baltimore	1919
Wilson, Edmund Beecher, New York (1916—E. B. Wilson and W. Bateson; 1921—W. Bateson)	1921
Osborn, Henry Fairfield, New York, Darwin Medal, 1918 (1915—A. Smith Woodward; 1920—E. Ray Lankester; 1925—E. Goodrich)	1926
Lusk, Graham, New York (1930—A. B. Macallum)	1932
Smith, Theobald, Princeton, Copley Medal, 1933 (1932—J. A. Arkwright)	1932
*Taylor, Hugh Stott, Princeton	1932
Cushing, Harvey, New Haven (1933—Wilfred Trotter and H. H. Dale)	1933
Langmuir, Irving, Schenectady, Hughes Medal, 1918	1935
Russell, H. N., Princeton	1937
American Medalists, not fellows of the Royal Society	
Buchanan Medal: William C. Gorgas	1912
Hughes Medal: Alexander Graham Bell	1913
Robert Andrews Millikan	1923
William David Coolidge	1927
Davy Medal: Edward W. Morley	1907
Arthur Amos Noyes	1927
Gilbert Newton Lewis	1929

Smithsonian on the list of Institutions to which the Phil. Trans. are prescribed; for confident anticipations are felt, and were expressed by several members of the Council who were present, that an Institution, which has commenced its public offices so worthily, will not fail to raise itself to a high and important station among those National Establishments, and Associations of Scientific and Literary men, whose express object it is to advance or to diffuse intellectual knowledge.

The Officers, Regents, and Members of the Smithsonian Institution may be assured that their progress in the honourable career which they have marked out for themselves will be regarded by the Royal Society with the liveliest interest, and the most hopeful expectations.

In writing to Sabine, Joseph Henry frequently talked about the Smithsonian. In November 7, 1849, he wrote:

I sent you a copy of our programme some time since with the request that you would favor me with any criticism with reference to it which might occur to you. To this I have not received an answer but I shall consider the remarks in your letter as an approval of the general plan. The programme is not in every respect what I could wish.

There were many persons to be consulted and we were consequently obliged to make some compromises to satisfy all parties. Mr. Bache and myself wished to establish the institution on the most liberal plan; namely that of doing the greatest good to the greatest number and to diffuse the benefits of the benevolent bequest of Smithson among men of every clime. We were however obliged to give way in part to local influence and to acquiesce in the expenditure of more money (from the income, not the principal), for the erection of a building than was necessary.

He was hopeful that the plan would be satisfactory. On November 10, 1860, he wrote:

For the last six or seven years we have gone on smoothly and harmoniously, previously to that time my position was a very disagreeable one. . . . I regret that in carrying out the plans for which I was induced to accept the charge [?] of the Institution I have been obliged to come in collision with the views and the interests of many individuals and consequently to call forth their opposition; but I have constantly leaned upon the support and approbation of those who are best qualified to judge of the worth of my labours. . . .

II

In the following account and in the Table, the proposers are cited because of the bearing their names have in the study of scientific relations and ideas.

A certificate first read on June 7, 1787, and accepted on April 3, 1788, follows:

James Bowdoin, Esquire, governour of the State of Massachusetts-Bay, president of the American Academy of Arts and Science in Boston, and author of several essays and letters on philosophical subjects, being desirous of becoming a fellow of the Royal Society on the foreign list, we, whose names are hereunto subscribed, do, from our knowledge of his merit, strongly recommend him as highly deserving of the honour he requests, and likely to prove a very useful and valuable member.

Richard Price, R. Kirwan, Edward Bancroft, Richard Paul Jodrell, P. Jodrell, John Paradise, William Bentinck and Caleb Whitefoord signed the certificate. David Rittenhouse's certificate, first read on November 6, 1794, was signed by H. Cavendish, Jesse Ramsden, A. Shepherd, Alexander Aubert, Nevil Maskelyne and Caleb Whitefoord.

The proposal for Nathaniel Bowditch was presented eighteen times between the first reading of May 15, 1817, and the election, March 12, 1818. Ten readings was the usual course. Joseph Banks, Charles Babbage, John Pond, C. Blagden, J. F. W. Herschel, Thomas Young, Edward F. Bromhead, Alexander MeLeay and William Vaughan signed it. Audubon's certificate, read on December 10, 1829, balloted on March 18, 1830, is more interesting:

John J. Audubon, Esqre, of No. 79, Newman Street, Oxford Street (but at present in the United States of North America) a Gentleman eminently distinguished for his knowledge in Natural History, and especially Ornithology,—and Author of the splendid work on the Birds of America now in course of publication; being desirous of becoming a Fellow of the Royal Society . . . etc.

It was signed by Aylmer Bourke Lambert, John George Children, N. A. Vigors, Edward Hawkins, A. Sedgwick and H. Coddington.[6]

In connection with Bache's membership, his correspondence with Sabine is worth two quotations. He frequently talked about the Coastal Survey. On March 31, 1859, he had written,

The bestowal of the Victoria Medal by the Geographical Society was a most agreeable memento, and the notices of the Coast Survey from your side have been of the greatest use in defence against the attacks to which we are now and then subjected. . . .

In June of the same year, he added:

The "panic" and exhausted Treasury of the U. S. have made against our progress, but the popularity of the work has kept up the appropriations during the time of trouble.

After promising to cooperate with Sabine, he concludes:

I feel much pleasure by the interest which you inform me the Prince Consort takes in our observatory.

In discussing the medal claims, and in giving the list of membership proposals never made effective, it is just as well to note here that it is quite as significant for the more detailed study of scientific relations as the successful list, and implies no derogation of the proposed or the proposer. Few awards or few places among the fifty foreign fellows, or untimely death, or the vagaries of balloting would be some of the reasons for not entering the fold. Obviously, since *recommendations* are involved the language is most positive and gratifying.

Upon proposing A. A. Michelson for membership, W. Hicks wrote in 1902 that Michelson "is perhaps the foremost experimentalist in the domain of physical optics and is distinguished for the accuracy of his results as well as for his ingenuity in design." H. H. Turner said of G. W. Hill in 1902: "His work on the Lunar Theory has made a new epoch in the subject; and has had great influence in Planetary Theory also." In recommending G. K. Gilbert, A. Strahan said in 1915 that he is "distinguished for his work in all branches of geology in the United States, much of which has proved to be of world-wide significance."

[6] The certificate of the Englishman, G. W. Featherstonhaugh, elected 1835, is of interest. He is described as "a gentleman who has zealously promoted the cultivation of geology in the United States," and who is now to conduct an extensive geological and mineral survey of the U. S. The certificates of Phineas Bond, 1815, and of Thomas Cooper, 1791, should be noted.

Joseph Larmor said of W. W. Campbell, 1916, that he has "contributed very substantially by his observations to the foundations of stellar and solar astronomy." In the proposal of 1920, E. Ray Lankester characterized H. F. Osborn as "the most distinguished living paleontologist." A. B. Rendle writes in 1925 that Sargent "has made the Arnold Arboretum one of the foremost botanical gardens of the world and whose active encouragement of horticultural exploration has added a great number of valuable economic and ornamental trees and shrubs to the collection of both Old and New Worlds."

A. B. Macallum in 1930 described Graham Lusk as "the outstanding physiologist in the United States." Wilfred Trotter spoke of Cushing's work in these terms: "Our present knowledge of pituitary fracture and disease and such control of them as we possess are largely due to work he has done or inspired." In proposing William Henry Welch, John G. Adami said in 1917: "to whose influence, more than to that of any other man is due the outburst of medical research in the United States which has characterized this generation."

We can not discuss the proposals which may still be valid for membership. It is sufficient to note that they bear out the observation of the accelerating progress of science in America since the war. The following were at one time placed before the society:

Edward Cope, (proposed 1896, by E. Ray Lankester).
Charles A. Schott, (proposed 1899, by Ettrick W. Creak).
C. Hart Merriam, (proposed 1911, by M. R. O. Thomas).
Henry Howe, (proposed 1921, by R. A. Hadfield).
Charles S. Sargent, (proposed 1925, by A. W. Hill, A. B. Rendle and Frederick Keeble).

Before recounting further some of the expressions of opinions involved in presenting the American scientist to the British mind, it is necessary to explain briefly that the Copley Medal is awarded to the living author of such philosophical research, either published or communicated to the society, as may appear to the council to be deserving of that honor. The subject or subjects of research must be specified in making the award; there is no limitation as to nationality. The Davy Medal is awarded annually for the most important discovery in chemistry made in Europe or "Anglo-America"; the Darwin Medal, biennially, in reward of work, especially in biology, in any country; the Buchanan Medal every five years for distinguished service in hygienic science or practice in any country; the Sylvester Medal, triennially, for encouragement of mathematical research in any country; the Hughes Medal, annually, in any country for original discovery in the physical sciences, particularly electricity and magnetism or their application. The Rumford Medal is awarded once every second year for discovery or useful improvement on heat or on light.

In announcing the award of the Copley Medal to Louis Agassiz in his presidential address, November 30, 1861, Sir Benjamin Collins Brodie said:[7]

> The results of these inquiries, and those of his fellow-labourers, Clark and Weinland, are embodied in the magnificently illustrated monograph entitled "Contributions to the Natural History of the United States," works which do equal credit to the naturalists who planned them, and to the State and people whose intelligent munificence renders their publication possible.

It is significant that the first award since we had become a nation went to a famous émigrant!

Upon the occasion of awarding the Copley Medal to the first indigenous product, Dana, Sir Joseph Hooker in his presidential address, November 30, 1877, spoke of his recent visit to the States.[8] He detailed the work being done at the Harvard College Observatory, the survey conducted by Dr. Hayden and his own interest in American flora.

> I must not end my notices of some of the labours of our scientific breathern in the United States without expressing my admiration of the spirit and the manner in which the Government and people have cooperated in making known the physical and biological features of their country, and my conviction that the results they have given to the world are, whether for magnitude or importance, greater of their kind than have been accomplished within the same time by any people or government in the older continent.

However, in 1875, Professor Leidy had been proposed for the Copley Medal, especially for his researches "On the Extinct Mammalian Fauna of Dakota and Nebraska." Dana's claims were put forward by P. M. Duncan, 1877, for work done in mineralogy and geology, and for his books on those subjects well known to the general reader.

> Dana may be considered as the Lyell and Miller of the United States; but he is in advance of any European philosopher in his personal knowledge of the grand and minute phenomena which refer to physical geography in its relation to physical geology.

Simon Newcomb was first proposed for the Copley Medal in 1880 by E(dwin) D(unkin); not since 1850 had the medal been given to an astronomer. In 1889 he was proposed by W. Huggins, in particular for his investigation of the moon's secular acceleration, the discussion of solar parallax and the determination of the velocity of light, and again in 1890 by W. H. M. Christie.

In 1884 there were two Americans considered for the Rumford Medal, Samuel P. Langley and Henry

[7] Proceedings, Vol. XI, pp. 461–462.
[8] *Ibid.*, Vol. XXVI, pp. 438–446.

Rowland. William Abney urged it for Langley because of his searches in solar physics, but especially for his investigations on the radiant energy of the sun, and his determination of the wave-lengths of the dark rays of low refrangibility from λ 12,000 to λ 28,000. G. Carey Foster had proposed Rowland for his spectroscopic study of radiant heat and light, and the determination of the value of the mechanical equivalent of heat, and generally as one of the founders of the *American Journal of Mathematics*. As professor of physics in the Johns Hopkins University, "he is at the head of the most important school of physical research in America." Langley was again proposed in 1886 by Rayleigh; and so was Rowland in 1888 by W. H. Preece, who added that before the British Association he had exhibited a map of the solar spectrum which in clearness of definition and for magnitude exceeded anything seen before, and again in 1890 by J. J. Thomson.

J. J. Thomson put forward Willard Gibbs's name in 1890 and 1891 for the Davy Medal because of his paper on the "Equilibrium of Heterogeneous Substances" which will have a great influence on chemistry. Oliver Lodge proposed Gibbs again in 1894. In 1901, H. E. Armstrong proposed him for the Copley Medal because of his contribution to the "phase rule."

R. T. Glazebrook put forward A. A. Michelson's name in 1894 for the Rumford Medal, mentioning the paper read before the British Association at Edinburgh in 1892, for his work in experimental optics and the use of the interference refractometer for the study of the distribution of light in a spectral line. H. F. Newall proposed him for the Copley Medal in 1906 in the same terms "and for having introduced a new order of refined precision into an already precise subject." William Huggins reproposed him in 1907, saying, "Michelson's genius has opened up new ground in experimental optics."

H. B. Dixon in 1903 suggested E. W. Morley for the Davy Medal because of his work on the atomic weight of oxygen by determining the proportion, both by weight and volume, in which oxygen and hydrogen combine. "No startling discoveries can be expected to reward such labours, but every chemist is indebted to him for the establishment of a constant of the first importance." He was reproposed in 1907 by A. Scott. For the industrial development of the electrical industry, Elihu Thomson was named for the Hughes Medal in 1906, and in 1907 by S. P. Thompson, who wrote, "He has been conspicuous in maintaining a high scientific level in his work as an electrical engineer."

In proposing G. W. Hill in 1907 for the Copley Medal, H. F. Newall quotes Sir George Darwin's tribute to him in an address to the British Association in South Africa for his work in the determination of perpetual orbits and their stability. It is suggested that he lay the point of departure for Poincaré, Darwin, E. W. Brown, Hough and others. David Gill, repeating the proposal in 1909, praised his work on the moon's motion, and herein his "introduction and development of the principle of disturbed periodic orbits has given an entirely new direction to the science. . . ." "All his work is characterized by its original points of view combined with practical aims, by maturity of thought and high suggestiveness. It forms an index of the simplicity and aloofness of its author who has been one of the main ornaments of Astronomical Science for more than a generation."

Herbert B. Baker, suggesting T. W. Richards for the Davy Medal in 1910, writes, "it is probably no exaggeration to say that he has done more to raise the standard of accuracy in physico-chemical work than any other living chemist. He has supplied some of the most rigorous proofs of the universality of Faraday's Law."

Much historical interest attaches to Ronald Ross's nomination of William Crawford Gorgas in 1912 for the Buchanan Medal. Gorgas possessed complete knowledge of all sanitary organization in the tropics and the qualities necessary to insure its success.

> But in addition to these qualifications, which are possessed by many good sanitary officials, Colonel Gorgas has been called upon to lead the way for the first time in the prevention of a new class of diseases, namely, those that are carried by insects. His first work in this direction in 1901 coincides with my first recommendations on the subject, but was, I believe, largely independent of them. . . . If the Buchanan Medal is to be given principally for sanitary practice, I cannot conceive a more worthy candidate for it than Colonel Gorgas.

For his work in applied sciences, Alexander Graham Bell was suggested by E. W. McBride in 1913 for the Hughes Medal. Joseph Larmor in 1914 put forward the name of R. W. Wood for the Rumford Medal in these terms: "His treatise on Physical Optics bears the individual impress of his own work, and is remarkable for the wealth of ingenious and striking experiments of which it contains a record." His work on the subject of optical radiations was also noted. A second proposal in 1924 by T. R. Merton says, "His investigations of the time interval between the absorption and emission of light in fluorescence are an example of the great ingenuity and experimental skill which is characteristic of his work."

As early as 1918, G. C. Bourne was suggesting Thomas Hunt Morgan for the Darwin Medal.

> Prof. Morgan's works have been noteworthy for their grasp of fundamental principles, and for the critical faculty which has enabled him to distinguish the weak points

in current evolutionary doctrines, and to undertake researches directed to the elucidation of obscure and doubtful principles.

He has largely advanced the knowledge of the "phenomena of coupling and repulsion," and has added to the knowledge of sex-linked inheritance, and has contributed to an explanation "of the part played by the chromosomes in inheritance. . . ." With a tribute to Morgan's disciples, J. T. Wilson in 1922 reaffirmed that Morgan's "Monograph on the Development of the Frog's Egg" is still a classic, and that the treatise on "Regeneration" at once became, "and still is, the leading authority on the subject in our language." His work has been in favor of "the complete and accurate correlation of the two sets of facts, cytological and 'Mendelian.'" E. S. Goodrich recommended Morgan in 1924.

Also in 1918, W. A. Herdman suggested Henry Fairfield Osborn for the same medal. One of the results of his work is

the more precise determination of the relative ages of the extinct mammals in North America, and that has led to the correlation between the order of succession of the mammalia in Europe and America. . . . All his work has been of an evolutionary character. He has written on the bearing of palaeontology upon Darwinism, and it seems most appropriate that he should be the recipient of the Darwin medal.

In putting forth the name of R. A. Millikan, 1923, James Jeans wrote, "He is proposed for the Hughes Medal especially for his determination of the electronic charge e and of Planck's constant h. . . . His determination of h was not only remarkable in itself, but was of still greater value as finally vindicating the Einstein-Bohr view of the nature of the photo-electric phenomenon." Jeans also wrote of George Ellery Hale for the Copley Medal in 1924. He enumerated Hale's spectroheliograph and the discovery of the Zeeman effect in the faint light emitted by the umbrae of sunspots.

Prof. Hale's outstanding eminence rests on a combination of three qualities each of which he possesses in extraordinary degree: first, a remarkable ingenuity in the design of astronomical instruments; second, skill and enthusiasm which enable him to get the utmost out of the instruments he has designed and third, a power of multiplying many-fold the productivity of his ideas by inspiring his co-workers with his own enthusiasm.

Rayleigh wrote in 1932 of Hale's spectrohelioscope,

We may confidently expect that it will contribute to clearing up the mysterious relations between terrestrial magnetism and solar phenomena.

James Walker wrote in his suggestion for the Davy Medal in 1927:

Prof. Arthur Amos Noyes was the torch-bearer of the modern theories of solution to the West . . . Noyes has exercised a great influence on physical chemistry, not only by the value of his experimental work, but by his careful analysis of the fundamental concepts of the science, and by his clear and logical presentations of their nature and their interrelations.

His work on electrolytic solutions, the velocities of reactions of different orders and reaction-velocity in heterogeneous systems was specified.

It was said of Edmund Beecher Wilson in a proposal for the Copley Medal in 1926 by J. H. Ashworth that "his papers on the development of the earthworm (1887, 1889) and on the cell-lineage of Nereis (1892) are classics, and were the models for numerous subsequent studies on the embryology of invertebrates." Further, "By his own investigations and by those of his pupils, Professor Wilson has exerted a far-reaching influence on the progress of cytological knowledge during the past thirty years." Similar proposals were made by E. S. Goodrich in 1931 and 1932.

Arthur Lapworth considered Gilbert Newton Lewis one of the leaders of modern physical chemistry, especially in chemical thermodynamics, and in proposing him for the Davy Medal he spoke of his valuable work in the field of electrode potentials; "his recognition of the fundamental importance of the electron duplet have greatly influenced the development of modern chemical theory." W. D. Coolidge was recommended for the Hughes Medal by R. T. Glazebrook in 1927. Joseph A. Arkwright in 1932 and 1933 suggested Theobald Smith for the Copley Medal, saying that in 1896–98 he first clearly distinguished between the human and bovine types of *Bacillus tuberculosis* and the forms of disease which they produce, "preceding Koch's pronouncement in 1901." Later work was adumbrated.

Thus, in one small part of the chronicles of British science has the course of American science been traced. It is pleasant narration because of the material used; a fuller picture might well have more shadows.

SCIENTIFIC EVENTS

LIVERPOOL CANCER COMMISSION OF INQUIRY

THE London *Times* reports that on the initiative of Lord Derby, a commission of leading Liverpool medical men and others has been appointed to report on the work being done in the Liverpool area in the investigation and treatment of cancer and on possible extensions and improvements of that work. The members of the Liverpool commission are: Dr. Arnold D. McNair, vice-chancellor of the university, *chair-*

man; Professor R. E. Kelly, professor of surgery; Dr. Henry Cohen, professor of medicine; Dr. James Chadwick, Lyon Jones professor of physics, Nobel prizeman in physics; Dr. A. Leyland Robinson, professor of obstetrics and gynecology, and Roland H. Thornton, Alfred Holt and Company, chairman of the Associated Voluntary Hospitals Board.

The terms of reference to the commission are to examine and report on the work being done in the Liverpool area in connection with the treatment of cancer and the investigation in all its aspects of the cancer problem; to examine and report on methods of extending and if possible improving this work in the Liverpool area and of giving the maximum effect to all the scientific, clinical and financial resources available therein for these purposes, with particular reference to:

(1) The best use consistent with the welfare of patients of the hospital accommodation and research facilities available in the voluntary and municipal hospitals in the Liverpool area and in particular in the Liverpool Radium Institute and the Hospital for Cancer;

(2) The most promising lines of investigation in regard to cancer (its causes and treatment) capable of being pursued in the Liverpool area.

(3) The feasibility of coordinating, if that should seem desirable, the various activities involved, whether by bringing these activities under some unifying board or authority or by some other method.

The commission will proceed at once with its work and will ask for evidence from all persons who can in their opinion be of service in the inquiry.

INVESTIGATION OF THE PILCHARD FISHERY

A NEW section of the Division of Scientific Inquiry of the Bureau of Fisheries has been established on the Pacific Coast for the investigation of the pilchard fishery. O. E. Sette, formerly in charge of the North and Middle Atlantic Fishery Investigations staff, will head the new section. L. A. Walford will serve as assistant to Mr. Sette and will have charge of certain phases of the investigation.

Headquarters for the investigation have been established at Stanford University. Two junior aquatic biologists, an assistant statistical clerk and a junior clerk stenographer will be appointed.

Dr. Ray Lyman Wilbur, president of Stanford University, has expressed his cordial interest and desire to cooperate in the investigation by furnishing quarters. The State of California will cooperate in the pilchard studies by furnishing statistical data from certain of the fishing areas.

The pilchard fishery at present produces considerably more than a billion pounds annually. Most of the catch is taken by California fishermen. The increased exploitation to which the fishery has been subject during recent years has given rise to fears that the fishing strain may be greater than the fishery can support. It is believed by some investigators that the fishery is taking undue toll of immature individuals, thereby endangering the spawning reserve.

The primary purpose of the current investigation is to determine whether over-exploitation exists and what form of regulation, if any, will be necessary to conserve the resource. The first year's activities will be directed toward measurement of changes in abundance, detection of seasonal and yearly changes in size or age composition of the population and the development of satisfactory methods for determination of age, a problem that has not yet been solved for the Pacific sardine.

Airplanes will be used in an attempt to discover whether unexploited units of the pilchard population exist in waters not frequented by commercial fishermen. It is planned that a fishery observer accompany naval pilots on routine practice flights offshore.

THE FLOODS IN SOUTHERN CALIFORNIA

REPORTS from field engineers of the Water Resources Branch of the Geological Survey in California furnish information about the recent record-breaking floods in southern California. The five-day storm that caused the floods extended from February 27 to March 3 and covered Los Angeles, Orange, Riverside, San Bernardino and Ventura Counties. The depth of precipitation is said to have totaled about 14 inches as an average on the area; the maximum 24-hour rainfall at Los Angeles was 6.25 inches. The total storm rainfall at Mt. Wilson was 26 inches, of which 12.81 inches came in a 24-hour period.

The storm is reported to have been the most severe in southern California in a period extending back at least to 1884. Preliminary information indicates that extraordinarily excessive rates of discharge were experienced in the flooded streams. Flood discharges as high as or higher than 700 second-feet per square mile were common. This compares with rates of 100 to 250 second-feet per square mile, which represent the maximum rates previously recorded on southern California streams. The inflow of San Gabriel River into the reservoir created by San Gabriel Dam No. 1 is estimated as 92,000 second-feet, the drainage area being approximately 200 square miles. This discharge was smoothed by the storage in this reservoir and that in the Morris reservoir next below, to 52,000 second-feet.

The highest previously known flood discharge in San Gabriel River at Azusa at the mouth of the canyon with a drainage area of 214 square miles was 40,000 second-feet in 1916. The flood flow of the Santa Ana River at San Bernardino was estimated as 75,000 second-feet as compared with a previous maxi-

mum of 40,000 second feet in 1916. It appears, therefore, that flood discharges were 2 to 2½ times the maxima recorded in periods extending back at least as much as and probably considerably more than 22 years. The loss of life apparently exceeded 200; and 10,000 or perhaps more were made homeless. The damage along the foothills due to mountain torrents rushing through cities and orchards was very great. Newspaper headlines placed the flood damage at $18,000,000.

In Los Angeles County alone 100 bridges were reported to have been lost. The district engineer reports that the damage to stream measurement stations of the Geological Survey includes ten that were wrecked and twelve or more severely damaged. On March 7 it had still been impossible to reach twelve of the stations.

THE SEVENTH HANCOCK PACIFIC EXPEDITION

THE seventh Allan Hancock Pacific Expedition returned to Los Angeles, Calif., on March 13, with large collections of marine invertebrates, fishes, reptiles, birds and mammals as material for research in the various institutions which have collaborated with the Hancock Expeditions in their accumulation, but particularly in the University of Southern California, at which has been newly established the Allan Hancock Foundation for Scientific Research. According to an announcement made at the time of departure of the seventh expedition, the first project of the foundation will be the erection upon the university campus of a suitable building in which the collections may be deposited and where they may be studied by qualified investigators.

The 1938 expedition sailed from Los Angeles harbor on January 3 aboard the Diesel cruiser *Velero III*, Captain G. Allan Hancock, founder of the expeditions, commanding. The scientific personnel included Messrs. John Garth, Fred Ziesenhenne, Alex Hill and Granville Ashcraft, of the University of Southern California; Dr. George S. Myers, of Stanford University; Dr. Hubert Lyman Clark, of the Museum of Comparative Zoology, Harvard University; Dr. E. O. Palmer, W. Chas. Swett, Hall Funke and Hugh Merrick, of Hollywood; Änker Petërsen, of Beverly Hills, DeWitt Meredith, of Glendale, and Messrs. Karl Koch and Cyrus S. Perkins, of San Diego. The latter two collected and attended to the living animals for the Zoological Society of San Diego, which included by the time San Diego was reached on the return voyage, Peruvian sea lions, a capybara, agoutis, monkeys, marmosets, spectacled bears, an ocelot, a wild dog, an Ecuadorean fox, many species of birds, including Humboldt penguins and the Andean condor, a crocodile, a fer-de-lance, a large tortoise from the Galapagos, and many iguanas from the Galapagos and Panama. Mr. Perkins also secured many reptiles f the Hancock collections, while fishes, of which a lar series were preserved, were attended to by Dr. Mye Birds and mammals were the special interest of M Ashcraft. Messrs. Garth, Hill and Ziesenhenne a tended to the invertebrates, chiefly marine, while D Clark concentrated his attention on echinoderms, which more than 160 species were secured. Dr. Palm was the invaluable medical officer of the expeditio Mr. Petërsen, artist; Mr. Meredith, scribe, and conta man particularly at the South American ports, wh Mr. Funke assisted Chief Officer Swett in the impo tant and continuous photographic record of the exp dition. The *Velero III* is completely equipped in eve detail for zoological field work and under Capta Hancock's efficient and very wise leadership every po sible opportunity is given the field workers and eve conceivable need is supplied.

Following the coast of Lower California, Mexico an Central America nearly to Costa Rica, stopping fr quently for dredging and now and then for shore co lecting, the *Velero III* then turned to the southwest an spent a very profitable two days at Cocos Island, a uninhabited but extraordinarily beautiful island n often visited by zoologists. Tower Island in the Gal pagos was the next stop and two weeks were spent this group, eight of the most interesting islands bei visited and much dredging being carried on. T *Velero III* then called at Callao, Peru, and from the followed the coast southward about three hundr miles to San Juan, where the sea lions were secure A stop at Independencia Bay on the northward voya yielded penguins for the zoological gardens at S Diego. Then followed a week visiting the famous "bi islands" of Peru, where millions of sea birds fi homes and protection. A few days were spent Guayaquil, Ecuador, while the photographers and so of the zoologists made a three-day excursion into t Andes, returning with the condor and spectacled be Between Guayaquil and Balboa, Canal Zone, dredgi and shore collecting were done at three well-separate stations. At Balboa opportunity was afforded for visit to the biological laboratory at Barro Colora Island. After leaving Balboa four collecting statio for the marine zoologists provided much addition material, but the steady decrease in warmth as t tropics were left behind necessitated haste in getti the menagerie to their destined home in San Dieg where it arrived in good condition on March 11.

Correspondent.

RECENT DEATHS

DR. W. L. POTEAT, president emeritus of Wak Forest College, N. C., who held the chair of biolog at the college for fifty-four years, died on March 1 He was eighty-one years old.

DR. EDWARD MARTIN, emeritus professor of surgical physiology at the University of Pennsylvania, died on March 17 at the age of seventy-nine years.

FREDERIC ALBERT MOLITOR, consulting railroad engineer of New York City, died on March 12, at the age of sixty-nine years.

KURT WALWER, vice-president and director of Pfaltz and Bauer, Inc., died suddenly on March 9. He was forty-six years old.

MAJOR FREDERICK GEORGE JACKSON, the British Arctic explorer, died on March 13, at the age of seventy-eight years.

A REUTER'S dispatch reports that Professor Gustav Bayer, of the University of Innsbruck, has died by suicide. He is said to have poisoned his daughter and then himself, presumably to escape possible arrest by the Nazi government. Other deaths by suicide include Professor Gabo Nobl, dermatologist and head of the Vienna General Clinic, and his wife; Professor Wolfgang Denk, head of the second surgical clinic of the University of Vienna, and Dr. Jonas Borak, x-ray specialist.

SCIENTIFIC NOTES AND NEWS

A SYMPOSIUM in appreciation of the scientific contributions of William Wallace Campbell, director emeritus of Lick Observatory and president emeritus of the University of California, will be held at the Harvard College Observatory at 3:00 P. M. on March 31 with Dr. Annie J. Cannon as chairman. The following papers will be presented: "Biographical Sketch," Dr. Harlow Shapley; "Eclipses and Eclipse Expeditions," Dr. Donald H. Menzel; "Planetary Atmospheres," Dr. George Z. Dimitroff; "Pioneer Studies of Stellar Spectra," Dr. C. Payne-Gaposchkin; "Spectroscopic Binaries," Dr. Samuel L. Thorndike (Wellesley College); "Stellar Motions," Dr. Priscilla F. Bok, and "Nebular Spectroscopy," Dr. Fred L. Whipple. It will be open night at the observatory, and Dr. Charles H. Smiley, of Brown University, will give an illustrated lecture entitled "The Story of the Lick Observatory."

AT the fifth annual meeting of the American Institute of Nutrition, to be held in Baltimore on March 30 at the time of the meeting of the Federation of Biological Societies, there will be a dinner in honor of Professor Russell H. Chittenden, emeritus professor of physiological chemistry of Yale University, director of the Sheffield Scientific School from 1898 to 1922. The speakers will be Dr. Mary S. Rose, president of the institute and editor of the *Journal of Nutrition*, and Professor Chittenden, who will speak on "Some Changing Viewpoints in Nutrition."

DR. STERLING TEMPLE, director of the Roessler and Hasslacher Chemicals Department of the E. I. du Pont de Nemours and Company, Niagara Falls, N. Y., has been awarded the Jacob F. Schoellkopf Gold Medal of the Western New York Section of the American Chemical Society. The medal is given for distinguished service in chemical research. Dr. Temple is the eighth chemist to receive the award, which was founded in 1931 by Jacob F. Schoellkopf, industrialist and financier of Buffalo.

THE John Fritz medal was presented to Dr. Paul Dyer Merica, vice-president of the International Nickel Company, at a dinner given in his honor on March 17 by the American Institute of Mining and Metallurgical Engineers. The medal was awarded in recognition of his "important contributions to the development of alloys for industrial uses." R. C. Allen, past president of the institute, presided at the dinner. Arthur S. Tuttle, chairman of the 1937 John Fritz Medal Award Board, made the presentation. Dr. Zay Jeffries, of the General Electric Company, Nela Park, Cleveland, reviewed the career and achievement of the medalist, after which Dr. Merica responded. The award of the John Fritz Medal is made jointly by the four national engineering societies—the American Society of Civil Engineers, the American Society of Mechanical Engineers, the American Institute of Electrical Engineers and the American Institute of Mining and Metallurgical Engineers.

THE Sir Edward Frankland Medal and Prize of the British Institute of Chemistry was presented to L. Smith, of the Sir John Cass Technical Institute, at the sixtieth meeting of the society, which was held on March 1. The Meldola Medal was presented to R. P. Bell, of Balliol College, Oxford.

THE James Alfred Ewing Medal of the British Institution of Civil Engineers has been awarded to Charles Samuel Franklin. The medal, which was founded in 1936, is given irrespective of membership in the institution "for specially meritorious contributions to the science of engineering in the field of research."

THE following awards were made at the recent meeting in Toronto of the Royal Canadian Institute of Mining and Metallurgy: The Barlow Memorial Prize to Dr. H. C. Gunning, of the Geological Survey, for the outstanding paper submitted during 1937 on applied or economic geology; the Randolph Bruce Gold Medal to E. L. Longmore, for many years mill super-

intendent of Hollinger Gold Mines, South Porcupine, Ont., the award being made for outstanding contributions to the art of treating gold ores; the Inco Medal to Robert Lepsoe, research chemist, of the Consolidated Mining and Smelting Company, Trail, B. C., as a distinction for his successful work on the recovery of sulfur and sulfuric acid from smelter gases.

AMONG honorary degrees conferred by Boston University on March 14, Founders' Day, was the doctorate of laws on Dr. Leonard Carmichael, president-elect of Tufts College, and the doctorate of science on Dr. William Elisha Chenery, laryngologist and trustee of Boston University.

THE doctorate of laws will be conferred at the spring graduation ceremony of the University of Aberdeen on Edwin John Butler, secretary of the Agricultural Research Council since 1935, and on Gunnar Dahlberg, director of the Institute of Medical Genetics, Uppsala, Sweden.

PROFESSOR E. S. GOODRICH, Linacre professor of zoology and comparative anatomy in the University of Oxford, has been elected a member of the Section of Zoology of the Royal Swedish Academy of Science.

DR. RAYMOND GRÉGOIRE, professor of surgery in the faculty of medicine of the University of Paris, has been elected a fellow of the Academy of Medicine.

PROFESSOR LORRAIN SHERMAN HULBERT, emeritus professor of mathematics at the Johns Hopkins University, was eighty years old on March 8. To celebrate the occasion, a number of his colleagues gave him a dinner on that day at the Johns Hopkins Club.

DR. LEE A. DUBRIDGE, Harris professor of physics and chairman of the department, has been appointed dean of the faculty of arts and sciences of the University of Rochester. He succeeds Dr. Leonard Carmichael, who has been elected president of Tufts College.

A CORRESPONDENT writes: "The department of psychology at Clark University has now been remanned by the appointment of two additional members. Dr. Raymond B. Cattell, who received his training at the University of London, has accepted an associate professorship of genetic psychology. Donald E. Super, trained at the University of Oxford and Columbia University, has accepted the position of assistant professor of educational psychology. These two men will report for duty at the opening of the next academic year in September."

J. S. TURNER, for the last three years demonstrator in botany at Selwyn College, University of Cambridge, has been appointed professor of botany at the University of Melbourne.

DR. NORMAN MACL. HARRIS, chief of the Laboratory of Hygiene of the Department of Pensions and National Health at Ottawa, having reached the age limit, will retire on April 1.

PRESIDENT ROOSEVELT has nominated Leo Otis Colbert, of Massachusetts, to be director of the U. S. Coast and Geodetic Survey. Mr. Colbert is now chief of the Division of Charts. He will succeed Dr. R. S. Patton, who died on November 25, 1937.

DR. IRVINE T. HAIG, since 1935 assistant chief of the Division of Silvics of the U. S. Forest Service, has been made chief of the division.

THE Missouri State Conservation Commission has appointed Arthur L. Clark, of Hartford, Conn., director of the Connecticut Fish and Game Department, to be head of the newly established section of fish, game and forestry.

DR. GUY FRANKLIN MACLEOD, professor of entomology at Cornell University, next year has leave of absence, which he will spend as research associate in the division of agriculture of the College of Agriculture of the University of California. His headquarters will be at Berkeley.

DR. G. J. HUCKER, chief in research in bacteriology of the New York State Agricultural Experiment Station at Geneva, has returned to the station following an absence of several months in New Zealand, where, upon the invitation of the New Zealand Ministry of Agriculture, he was engaged in a study of bovine mastitis and in the organization of a research program dealing with the causes and control of mastitis under New Zealand conditions.

PROFESSOR S. A. MITCHELL, director of the Leander McCormick Observatory of the University of Virginia, gave a lecture on March 17 under the auspices of the New York University Chapter of Sigma Xi on the joint expedition to observe the total eclipse of the sun made by the National Geographic Society and the U. S. Navy.

DR. JOHN VON NEUMANN, professor of mathematics at the Institute for Advanced Study at Princeton, gave on March 11 the sixth of a series of Dohme lectures at the Johns Hopkins University.

DURING the first week in March, Dr. Walter A. Shewhart, of the Bell Telephone Laboratories, gave a series of four lectures at the Graduate School of the U. S. Department of Agriculture. The subjects were: "Statistical Control"; "How to Establish Limits of Variability"; "How to Present the Results of Measurements of Physical Properties of Constants"; "The Specification of Accuracy and Precision."

DR. KURT GOLDSTEIN, professor of clinical neurol-

gy at Columbia University, lectured at Duke University on February 28 on "Changes in Abstract Behavior Produced by Brain Injury."

DR. F. VON WETTSTEIN, director of the Kaiser Wilhelm Institute for Biology at Berlin-Dahlem, lectured at the Iowa State College on March 10 and 11. His topics were: "Origin of Species in Plants" and "Plasmatic Heredity."

AT the twentieth anniversary meeting on March 21 of the National Committee for Mental Hygiene, which was held at McGill University, Lord Tweedsmuir gave an address on "The Mind of the Citizen"; Sir Edward Beatty reviewed organized mental hygiene work in Canada during the past two decades, and Dr. Livingston Farrand, formerly president of Cornell University, spoke on modern aspects of mental therapeutic work.

THE seventy-fifth annual meeting of the National Academy of Sciences will be held in the building of the academy on April 25, 26 and 27. The annual dinner will be held in the academy building on the evening of April 26. In compliance with the request of the Committee on Arrangements, President and Mrs. Lillie will be in the library to meet members and guests at 7:00 P.M. Luncheon will be served in the library at 12:30 on Monday and Tuesday and at the close of the business session on Wednesday.

THE third meeting of the Conference on Methods in Philosophy and the Sciences will be held at the New School for Social Research in New York on Sunday, May 8. The morning session will be in the nature of a symposium on problems of method in psychology. Dr. A. F. Bentley, Professor Kurt Lewin and Dr. Edwin B. Holt will contribute papers at this meeting. The afternoon session will be devoted to brief papers on and discussion of the effects of the growing trend towards authoritarianism on the practice of scientific method and the application of its results. Further information can be obtained from the secretary, Dr. Gail Kennedy, Amherst College, Amherst, Mass.

THE Kips Bay-Yorkville Health and Teaching Center at 411 East 69th Street, New York City, was dedicated on March 16. The ceremonies were presided over by Dr. John L. Rice, Commissioner of Health. The speakers included Mayor La Guardia, Dr. Edmund Ezra Day, president of Cornell University, and Dr. Livingston Farrand, president emeritus. The building, erected at a cost of $314,000, will be conducted by the city in cooperation with Cornell University Medical College and the Society of the New York Hospital. It will serve the district extending from 34th Street to 89th Street and from Fifth Avenue to the East River.

AT a recent dinner in New York City of alumni of the Carnegie Institute of Technology at Pittsburgh, President Robert E. Doherty announced that the sum of $1,450,000 had been raised toward the four million endowment fund. It is stated that this sum will be doubled by the Carnegie Corporation should the entire amount be collected by 1946.

APPLICATIONS for grants from the Cyrus M. Warren Fund of the American Academy of Arts and Sciences should be received by the chairman of the committee, Professor James F. Norris, Massachusetts Institute of Technology, Cambridge, not later than May 1. Grants are made to assist research in the field of chemistry. On account of limited resources, grants to an individual are seldom made in excess of $300. The application should be accompanied by an account of the research to be undertaken, a statement of the sum requested and the manner in which the money is to be expended.

Nature reports that in the congregation of the University of Oxford on February 1 the vice-chancellor announced that the claim of the company which has been suing the university for £750,000, following the conviction of B. J. Owen, formerly director of the Institute for Research in Agricultural Engineering, had been settled by a payment by the university of £70,000. This is said to end satisfactorily a trouble that has been threatening the university off and on during the past seven years. It began in 1926, when the director of the Institute for Research in Agricultural Engineering sold to the plaintiff company patents relating to the extraction of sugar from beet which were stated to be novel and excellent, but which proved to be worthless. The company believed that the director was acting throughout as agent of the university and that the representations he made in that capacity resulted in the loss by the company of much of its capital.

PUBLICATION of "The University of California Publications in Pharmacology," under the editorial supervision of Drs. Gordon A. Alles, T. C. Daniels, Mayo H. Soley and Chauncey D. Leake, has been announced. They will contain reports of original pharmacological studies from the university laboratories, together with occasional review and general articles. The studies will appear irregularly in a series, but will be consecutively paged to form volumes of about 500 pages. The first number will appear in the spring.

THE *British Medical Journal* states that a new journal dealing with the physiology and pathology of old age, entitled *Zeitschrift für Altersforschung,* began in January under the editorship of Professor E. Abderhalden and Professor M. Bürger. The journal will appear quarterly, and is published by T. Steinkopff, of Dresden and Leipzig.

IN the House of Delegates of the American Medical Association during the Kansas City session in 1936, Dr. Harrison H. Shoulders, of Tennessee, submitted a resolution for the development of a plan whereby suitable recognition in the form of a medal or a testimonial might be given to fellows of the association who have rendered distinguished service in the science of medicine. In accordance with this action, a special committee, known as the Committee on Distinguished Service Awards, consisting of five members, was established. The first committee includes: Drs. H. H. Shoulders, Tennessee; J. W. Amesse, Colorado; J. D. Brook, Michigan; J. F. Hassig, Kansas, and Grant C. Madill, New York. This committee is authorized to receive nominations for the award, which is to be given on the basis of meritorious service in the art and science of medicine. It will include a distinguished service medal and a citation.

DISCUSSION

SCIENCE AT THE UNIVERSITY OF CHICAGO

THE masterful presentation of Professor E. G. Conklin in his "Science and Ethics"[1] of the disciplinary and educational value of science and its place in and contribution to world society as well as the future outlook for science in general deserves the commendation of men in all branches of this large and productive division. Professor Conklin's long and able service in the Biological Sciences in America peculiarly fits him to adequately present the outlook both from retrospect and prospect. No one acquainted with him would ever call into question the seriousness of his purpose nor the fairness with which he attempts to portray in this thesis his own firm convictions. With due respect and appreciation of his point of view there are a great many men active in science in this locality who regret exceedingly the implications and attitudes that will be left in the minds of many by the statement on page 600, "The President of The University of Chicago has recently called science a failure in the educational process and has urged a return to philosophy as the only sure road to sound discipline and true culture."

Without making any attempt to consider argumentatively the proper understanding of any particular type of verbal or written statement, for such argumentation has already received many pages of attention, and particularly in consideration of the old truth, "Actions count for much more than words," it is the purpose of this short communication to attempt to modify to some extent the impressions that will have remained after reading this particular sentence.

The writer has served as a member of the science faculty of the University of Chicago under four presidents. My impressions are that (a) never before in the history of the institution have as great a number or as great a percentage of students been exposed to methods and content of science as at present; (b) with the possible exception of the original organization and beginning of the university, under President Harper, there has probably never been a greater impetus toward strengthening the faculties in science with men of the highest caliber obtainable under the existing conditions; and (c) a larger portion of available funds of the university are now devoted to scientific investigation, especially to pure research in science, than ever before.

It is generally known that the University of Chicago has embarked upon an experimentation with the curriculum, especially in the college, and this movement has had the vigorous support of President Hutchins. With regard to its effects upon science in general, several things have happened, among which brief mention may be made of the following: (a) Whereas previous to the reorganization of the curriculum, involving removal of many courses but no more in science than other divisions, the number of students in the first two years being exposed to any study of zoology was of the order of 250 to 300 per year, whereas at the present moment this number will be of the order of 700 students. Practically 100 per cent. of all freshmen and sophomores in the University of Chicago, and whether major students in humanities, social sciences or natural sciences, take courses in both the biological and physical sciences. Previous to the introduction of the new plan, first- and second-year students actually exposed to the laboratory disciplines in zoology numbered approximately 150, whereas under the new plan the number is of the order of 300. (b) Under the old régime the majority of freshmen and sophomore students came directly under the influence of perhaps one or two major instructors, whereas at present the number of major instructors in the biological sciences alone is 14; to this there should be added that some 5 or 6 younger men, having attained their Ph.D. degree, constitute the major assistance, practically all of whom are productive scholars in science.

During the depression Herculean measures were adopted to maintain intact the faculty of the entire university, and in some respects departments in science fared better than some departments in other divisions. Although the salary for faculty members on a four-quarter appointment in the clinical depart-

[1] SCIENCE, 86: 595–603 (Friday, December 31, 1937).

ments and of administrative officers were reduced, no salaries of faculty members on regular academic appointments in the university were reduced. With some little measure in financial relief, immediate and strenuous measures were taken to repair any damage and to increase the effectiveness of the various departments. Within the last two years scores of men have been added to the faculties to strengthen all phases of university work, and science, rather than being neglected, has been tremendously stimulated by the addition to all ranks of the faculty from instructor to distinguished service professor (the science division being the one and only instance in which a man has been appointed from outside the university to a distinguished service professorship). The head of one science department, requesting of President Hutchins the appointment of one of three good men believed to be available, was told that if all three men were *good* to get the three of them. This was done, with their appointments having been made as of October 1, 1937.

With regard to support for scientific investigation there has been no evidence of a recession, and no case is known to the writer where research programs have been curtailed. It is well known that during the depression the most strenuous measures were taken to provide necessary equipment, personnel and other requirements. Investigation in all branches of science is on the upgrade rather than experiencing retrogression. Whatever impressions have been gained from outside the university, therefore, should be evaluated in terms of actual existing conditions. Science is going forward to a degree even greater than in previous periods, which precludes any immediate danger that it will be overthrown at the University of Chicago.

CARL R. MOORE

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EFFECTS OF FREEZES IN SOUTHERN CALIFORNIA ON SHADE AND ORNAMENTAL TREES

IN the August 22, 1913, issue of SCIENCE this writer presented some observations on the effects of a hard freeze in January of that year on certain shade and ornamental trees in Redlands and vicinity. In particular, mention was made of the effects upon the Pepper, the Acacias, the Grevilleas and several varieties of Eucalypti.

In January of 1937, Southern California was subjected to another period of freezing temperature, which, according to official weather reports, exceeded in severity any previous record. In Redlands, where these records were obtained, twenty-one days of the month of January experienced temperatures of freezing or below. Eleven days experienced a temperature of 26 degrees or below. The mean temperature of the month was recorded as 6 degrees lower than ever before experienced here.

The effect of the 1937 freeze upon the trees of this vicinity is, however, so very different from that of 1913 that a brief comparison may be of interest. The damage produced by the 1913 freeze was very great, both upon the ornamental and shade tree varieties mentioned above and upon the citrus trees as well. The damage produced by the 1937 freeze was negligible.

In 1913 hundreds of trees were killed outright. Due to injudicious haste in removal, hundreds of others that doubtless would have recovered if left alone, were sacrificed. As pointed out in the 1913 article the ability of many trees to recover, even though apparently every shred of live bark was killed and peeled off, was remarkable. In numerous instances the production of adventitious buds covering the trunk from ground to many feet above ground was one of the notable features of the recovery. Following the 1937 freeze very few trees showed a splitting of the bark. Entire defoliation in some varieties, especially the Peppers, did occur to a considerable extent. The defoliation was frequently attended with destruction of the tender twig growth and in some cases larger limbs were killed. In some varieties, especially the Eucalypti, the peculiar fuzzy growth due to the development of adventitious bud growth is evident, even though no bark peeled off. I have seen no exudation of gum such as was very common in 1913.

Any attempt to explain the difference in the effects of the two freezes is, of course, attended with a degree of uncertainty. It is to be noted, however, that in 1913 the cold came on suddenly, and was attended by a high, dry, north wind. The cold lasted about two days only, and was followed by warm, bright, sunshiny days. The mean temperature for 1913 was considerably above average. Very few of the citrus growers in 1913 were equipped with "smudge pots" or heating equipment, and no considerable smudge smoke accumulated. As soon as the sun rose, its heat began to have an effect, and increasingly so throughout the day.

In 1937 the cold increased gradually and was unaccompanied by wind. A very considerable portion of the citrus acreage in and around Redlands is now under heat, and "smudging" or heating is now much more general than in 1913. The smudge smoke accumulated like a dense pall over the entire area, and persisted pretty much during the entire daylight hours for a period of several days. At no time for a period of several days at a time did the temperature rise much above freezing. When it did warm up it did so gradually. Almost without exception the orange trees

came through undamaged, though some of the lemon orchards suffered considerably.

One lesson learned from the 1913 freeze and put into effect in 1937 was the danger of undue haste in removal of apparently seriously damaged trees. Give nature a chance and she will repair her own damage to a very remarkable degree. Very few trees of any variety have been sacrificed in 1937.

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"IDEST"

IN reading—rather belatedly, I must admit—your issue of November 5 last, I was interested by Mr. C. H. Briggs's letter on page 423, headed "Idest: A Word for avoiding Ambiguity."

While fully agreeing with the point Mr. Briggs raises as to the unfortunate ambiguity frequently inherent in the use of "or," I do feel that his proposal to add to our unfortunate and overburdened language yet another word can only be justified on the score of dire necessity.

In the present case, I do not think this necessity arises. There is already available an expedient which has, I think, been used for a long time past. This expedient is simply the use of parentheses where the second word is merely an alternative term for the first. For example, instead of writing, as Mr. Briggs suggests, "Turkish idest Aleppo galls," "tannin idest gallotannic acid," "muriatic idest hydrochloric acid," why not simply "Turkish (Aleppo) galls," "Tannin (gallotannic acid)" "muriatic (hydrochloric) acid"?

G. R. L. POTTER

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THE MANUFACTURE OF KRAFT PULP AND PAPER

IN the account of the exercises in connection with the celebration at Fernandina of "Florida Industries Day" (SCIENCE, January 28, 1938, p. 82) it was stated: "Honor was paid to Dr. Charles H. Herty, by whose research in a small laboratory in Savannah the process of manufacture was discovered." This is an error which has frequently been made in recent weeks, particularly by correspondents of the daily newspapers not familiar with the history of the manufacture of pulp and paper.

In order that the situation may be clarified and justice done to all concerned, I hope that SCIENCE will reproduce the following extract from an address I made at a recent public gathering in Savannah, Georgia, which quotes textually and accurately my remarks bearing on this misunderstanding.

Too much credit has been given me in an over abundance of good will on the part of many of the daily newspapers. For instance, in its account of the Fernandina celebration about a month ago, the *New York Times* correspondent stated I was the discoverer of the process for making kraft pulp and paper.

This was so plainly an error it was not worth correcting to paper men, but in order that the record may be clear to all, let me say the kraft pulp and paper industry has been in existence in the South for the last twenty-seven years.

The man who was responsible for that development is a man living and working here in Savannah, namely Ed Mayo, who was a pioneer in the field and who struggled with those same difficulties, prejudices and skepticism which we have been going through in trying to start the news-print industry from pine in the Southern States.

CHAS. H. HERTY

REPORTS

PROGRESS OF THE NEW YORK ZOOLOGICAL SOCIETY

THE New York Zoological Society during the year of 1937 made definite strides forward in connection with certain of the activities to which it is dedicated. Before commenting on this progress, it may be said that the collections at both the Zoological Park and the Aquarium are extremely extensive in regard to both interest and number. At the close of the year there were at the park a total of 2,607 specimens, representing 988 species, and at the aquarium a total of 10,804 specimens, representing 480 species.

Among the rare and interesting acquisitions in the park during the past year were the following: The only Okapi that has ever been seen in this country; a pair of Roi Rhebok antelope, Beisa and Saiga antelope; a pair of Muntjacs; a giant armadillo; scarce birds of paradise; a pair of quetzals, which are the first ever exhibited in any zoological collection, and many other unusual specimens.

Among the most interesting acquisitions at the aquarium were a Madeira scorpion fish; a sea-bat; whip-snake eel; Nile puffer; pink wrasse; Chinese river turtles, Chinese alligator; Coecilians from South America; locust lobsters from Madeira; black-banded butterfly fish; black-barred squirrelfish; panther fish; Chinese fresh-water crabs; and many others. For the first time we have been able to discover more successful methods of keeping octopi alive. The difficult technique of maintaining this delicate animal is gradually being acquired.

During the year 2,655,870 persons visited the zoological park and 2,626,893 persons visited the aquarium.

Improved methods of interpreting the many fascinating facts and principles of zoology are gradually being developed, so that the public may come to see

living animals and depart with "living" ideas. The installation of an exhibition depicting the evolution of the lizard to the bird, which has recently been installed in the birdhouse at the park, is a preliminary step in this direction and has aroused wide popular interest.

Our educational services to students have been active, as indicated by the fact that during the past year 900 school classes registered at the park gates, and fourteen high schools and junior high schools availed themselves of the special tours of the park, conducted under the direction of our curator of educational activities. The use of our educational films and lantern slides is steadily being extended, showings having been made to a total of 71,560 students during the year.

The society is determined to develop its scientific activities in every way possible. The hospital and laboratory at the park is not only a place for the technique of keeping our animal population healthy, but it is being developed constantly as a center for biological and pathological research. An important opportunity lies open to the society in this direction. Active collaboration is being carried on at the present time with the following medical and scientific institutions: Mt. Sinai Hospital, New York University, Cornell University, College of Physicians and Surgeons, International Health Division of the Rockefeller Foundation, U. S. Bureau of Fisheries and Yale University. Students from some of these institutions are working daily in our laboratories.

The tropical research department, under the leadership of Dr. William Beebe, has already completed one expedition of five months' protracted study of deep sea life at the Bermuda Oceanographic Station, and is engaged at this writing in another expedition in the Pacific, carrying on the work started during 1936 in collecting data as to marine forms found off the west coast of Southern California and Northern Mexico.

As readers of SCIENCE are undoubtedly aware, the results of the scientific and technical work of our staff are published currently in *Zoologica*.

Definite advancement in the society's activities in the field of conservation is being made. The Wild Life Protection Fund, founded and carried forward until his death by Dr. William T. Hornaday, came under the management of the society in the early part of last year. In December the International Wild Life Protection Committee proposed that its activities be taken over by the society, and this additional work is being assumed. It is apparent therefore that our opportunities in carrying forward effective work in conservation, always an integral part of our activities, are increasing as time goes on.

We mourn the death of our former president, Mr. Madison Grant, which occurred on May 30, 1937. Among all his activities throughout his lifetime, his prime interest was always the Zoological Society—from its founding in 1895 through the years of its development and growth—until the very day of his death.

We regret the retirement of Dr. Charles H. Townsend (on November 2, 1937), who for thirty-five years so successfully conducted the aquarium. However, Dr. Townsend will continue his valuable contributions to the *Bulletin* and to *Zoologica,* as well as continue his study of the distribution of whales throughout the world.

In conclusion, it is apparent that the interest of the public in the wonders of the animal world are perennial and unceasing, of which a visitors list of more than five million persons a year is sufficient evidence. In addition to the administration of the zoological park and the aquarium, and the carrying out of its marine expeditions, the officers, board of trustees and administrative staff of the society are also doing everything in their power, with the means at their disposal, towards enlarging the society's usefulness in the boundless fields of education, scientific research and the conservation of wild life.

FAIRFIELD OSBORN

SPECIAL ARTICLES

THE X PARTICLE

FROM the studies of cosmic ray data physicists had come to the conclusion that the energy in cosmic radiation was carried by an unknown particle, the X particle. In 1936 Anderson and Neddermeyer discovered from an examination of cosmic ray tracks in cloud chambers what they conceived to be this new particle; a particle with the same charge as the electron but with very great penetrating power. Street and Stevenson almost simultaneously announced the detection of the same particle. From their measurements, the latter investigators concluded that it had a mass 130 times that of the normal electron. Corson and Brode[1] estimated from the track that they observed that the mass ratio is nearer to 700 than 130.

When Dirac set forth his relativistic theory of the electron in 1927 he advanced the opinion that there should exist a corresponding particle with a positive charge. The discovery of this particle, the positron, by Anderson from cloud chamber photographs of cosmic ray tracks constituted the major achievement resulting from cosmic ray studies. Since that time

[1] D. R. Corson and R. B. Brode, *Phys. Rev.* (A), 27, Stanford meeting, December, 1937.

Dirac[2] has constructed a mathematical model of a new particle which has the same charge as an electron but a spin greater than ½. The writer has proposed[3] that this latest prediction of Dirac's represents the newly discovered X particle. This note contains a summary of the properties of this particle to be expected on the basis of this latest Dirac theory.

If we let p_t and p_x represent the energy and momentum—the x component—operators of the wave mechanics, then the equations which describe the properties of the particle moving in the x direction in free space are $(p^2{}_t - p^2{}_x)\ \psi = (m\,c)^2\ \psi$ and $(p_t - A\,p_x)\ \psi = B\ (m\,c)\ \psi$, where A and B are matrices. If the spin of the particle is k units, the Hermetian matrix A is such that $A^2 = k\ (k+1)\ /3\,k^2$. The wave function may be written in the form $\psi = \alpha \exp. \frac{2\pi i}{h}\ (Wt + p_x X)$.

The question naturally arises whether or not for sufficiently high values of the energy W the term containing the mass of the particle m can be neglected. In that case the equations reduce to $(p^2{}_t - p^2{}_x)\ \alpha = 0$ and $(p_t - A\,p_x)\ \alpha = 0$. From the first equation we get $p_t = p_x$, so that the second equation can be written as $p_t\ (1 - A)\ \alpha = 0$. By manipulating the conjugate imaginary equation in the same manner, it can be shown that these equations have a solution only if A is such that $A^2 = 1$. Thus the mass term can be neglected legitimately for that case in which $k = \frac{1}{2}$ or expressed non-mathematically for the case of the ordinary electron. On the other hand, for the new X particle, the energy can never become so great that the mass calculated from the Einstein relation $W = m\,c^2$ is large compared to the rest mass m. Some very interesting properties of this particle can be deduced from this fact. 1. The ionization of a very high energy particle must be large compared to that of an ordinary electron of the same energy because the large value for the rest mass requires that the velocity never becomes comparable with the velocity of light. 2. The radiation will always be small in comparison to that of the same standard, the ordinary electron, because of the high value for its rest mass. This calculation is made under the restriction that the change in mass in this process can be neglected. 3. The X particle through a spin transformation can change its mass into kinetic energy at a nuclear collision. In this process a number of neutrinos sufficient to take care of the change in spin must be generated. The newly formed charged particle, in the limiting case an ordinary electron, will take the residual energy from this process off in the form of kinetic energy.

Properties of this nature for the X particle are perfectly consistent with the data on the new particle accumulated up to the present time. Exact analytical formulae for these various properties must wait until a rigorous solution of the spin matrices for large values of k is found. It is probable that the theory of ideal factors[4] will contain the key to their solution.

ARTHUR BRAMLEY

WASHINGTON, D. C.

[2] P. A. M. Dirac, *Proc. Roy. Soc.*, 155, July, 1936.

[3] A. Bramley, *Phys. Rev.* (A), 22, Madison meeting, June, 1937.

[4] Weitzenbock, "Invarianten-theorie," Groningen.

ADMINISTRATION OF OESTRONE TO YOUNG ALLIGATORS

RELATIVELY little study has been made of the effects of female sex hormone injections into reptiles. Kehl[1] stated that the administration of folliculin to sexually immature female turtles was followed by oviduct hypertrophy. Turner[2] injected theelin into adult male skinks; the result was a decrease in testis weight, a proliferation of germinal cells and a hypertrophy of the epididymides. Dantchakoff[3] introduced folliculin into incubating lizard eggs. Examination of the lizards after hatching revealed larger oviducts in both male and female experimental animals than were found in female controls. Dantchakoff stated that the control male oviducts disappeared before hatching. The injections also inhibited the development of the penis.

In the work to be reported here, 22 immature alligators of both sexes, 15 months old when injections began, comprised the experimental group. Sex can not be distinguished externally at this age. Eighteen of the animals were injected with a total of 9,300 R.U. (46,500 I.U.) of Progynon[4] each, evenly distributed over an 80-day period, while the remaining 4 animals received lesser amounts of the hormone. A similar group of 22 alligators served as controls.

Autopsy two days after the last injection revealed that there were 9 males and 13 females in the experimental group, and 7 males and 15 females in the control group. The oviducts of the injected females were so greatly hypertrophied as to distend the abdomen. Vestigial male Müllerian duct segments, difficult to locate even microscopically in normal males of this age, had so greatly hypertrophied under experimental treatment as to be readily visible macroscopically as small nodules, one of which lay just lateral to each testis in the injected males. The cloacae and penes or clitorides of the injected animals were not visibly affected.

Histological study of the testes showed that the persistent isolated areas of germinal epithelium, equivalent to a vestigial cortex and lying external to and penetrating the tunica albuginea of the normal testis

[1] R. Kehl, *C. R. Soc. de biol.*, 105: 512–13, 1930.

[2] C. D. Turner, *Biol. Bull.*, 69: 143–58, 1935.

[3] V. Dantchakoff, *C. R. Acad. des Sci.*, 205: 424–27, 1937.

[4] Supplied through the courtesy of Dr. Erwin Schwenk, of the Schering Corporation.

at this age, had in the experimental males undergone an average hypertrophy (with wide individual variation) of 355 per cent. as estimated by the camera lucida paper tracing method. The testicular medulla was not significantly affected. In the experimental females the ovarian cortex showed an average increase in volume of 94 per cent., due chiefly to a multiplication of oogonia, as compared to normal cortex. The increase in experimental ovarian medullary volume was not judged to be statistically significant. Microscopic examination indicated that the striking hypertrophy of the oviducts and the male Müllerian duct rudiments in the injected animals was due largely to an extensive growth of the mucosa, which often projected into the duct lumen in prominent longitudinal folds. The muscular strata of the experimental oviducts were also precociously developed as compared to those of the controls. Shell glands were not identified. The Wolffian ducts and mesonephroi of both sexes were unaffected.

Evidence of some degree of bisexuality in the normal females was found in the retention of fully formed Wolffian ducts many months after the mesonephros had ceased to be a secretory organ and in the persistence, in the posterior portion of the ovary, of a testis-like area of medulla lacking the typical cortical investment. This atypical medulla was not significantly affected by oestrone treatment. A degree of bisexuality in the normal male was indicated by the retention of vestigial Müllerian duct segments and by the persistence of fungiform cortical areas on the testis.

It is concluded from the experimental data that oestrone, when administered to sexually immature alligators under the conditions described: (1) produces testicular and ovarian cortical hypertrophy and (2) selectively stimulates the oviducts and male Müllerian duct segments without affecting the Wolffian ducts of either sex, and that (3) neither the oestrone nor the hypertrophied testicular and ovarian cortical components inhibit the testicular and ovarian medulla. An extended report of this experiment will be published later.

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THE FLAGELLATION OF BACTERIA[1]

NEARLY twenty years ago it was pointed out[2] that the apparent occurrence of both monotrichic and peritrichic species among the legume nodule bacteria might be explained on the assumption that all species have actually several flagella but appear monotrichic in young preparations. Attention was called to the fact that even with those species where only one flagellum can be found, it is as apt to be attached at the side of the cell as at the pole.

Smith and Brown[3] have published illustrations showing that *Bacterium radiobacter* is not unlike some of the nodule bacteria in this respect, appearing sometimes with a single flagellum which may be either polar or lateral, and sometimes with two to four peritrichic flagella. Verification of this observation has been secured by A. W. Hofer (of the writers' laboratory) and is to be published shortly. This fact, together with similar statements in the literature concerning the violet chromogens and other bacteria, has suggested that there may be a type of flagellation distinct from polar flagellation, on the one hand, and even from true peritrichic flagellation, on the other. Accordingly, a collection of various soil and water non-spore-formers has been secured and a series of flagella stains made from all of them.

The results in detail will be presented elsewhere. Here we wish merely to call attention to the fact that there does seem to be evidence of three distinct types of flagellation. Fig. 1 shows a typically peritrichic

FIG. 1. *Escherichia coli* Castellani and Chalmers, showing true peritrichic flagella. FIG. 2. *Bacterium parvulum* Conn, showing polar flagella. FIG. 3. *Bacterium radiobacter* Löhnis, showing possibly degenerate peritrichiate arrangement of flagella.

organism. Fig. 2 shows an organism with definitely polar flagella, most cells being monotrichic but a few showing two flagella at one pole. Fig. 3, on the other hand, shows the type of flagellation which is now under consideration. It is apparently a degenerate form of peritrichic flagellation, but the flagella are so few in number and all but one so often missing that unless an extensive study is made one might easily be tempted to call such a culture unquestionably monotrichic.

Attention is called to this point because it is felt that considerable confusion has occurred in the classification of bacteria in the past from trying to make a rigid separation between peritrichic and monotrichic

[1] Approved by the Director of the N. Y. State Agricultural Experiment Station for publication as Journal Paper No. 258, March 2, 1938.

[2] H. J. Conn and R. S. Breed, SCIENCE, 51: 391–2, 1920.

[3] F. B. Smith and P. E. Brown, *Iowa State Col. Jour. Science*, 10: 17–25, 1935.

organisms without realizing that type of flagellation may occur which is essentially peritrichic, although some cultures are monotrichic. True polar flagellation includes lophotrichic and definitely monotrichic organisms. True peritrichic flagellation is best shown by forms that possess four or more flagella. A degenerate type of peritrichic flagellation, on the other hand, may show one to four flagella and, if only one, the attachment may be either polar or lateral.

It is felt that much greater progress can be made in the classification of bacteria if organisms with only one flagellum are not separated from those which have three or four peritrichic flagella. A more satisfactory plan seems to be to group them on the basis of a correlation of characters. A considerable number of organisms have been observed (*e.g.*, the violet bacteria, the legume nodule organisms, *Bacterium radiobacter*, *Alcaligenes fecalis* and numerous still unidentified soil non-spore-formers) which either show this type of flagellation or else lack all flagella. These organisms resemble each other in their physiological characteristics. Such a classification as that here suggested, therefore, does not run counter to the prevailing systems of grouping bacteria, in which much weight is laid on fermentation reactions and similar characters, as well as on morphology.

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THE MOLECULAR WEIGHT OF CRYSTALLINE CATALASE[1]

THE apparent relationship of the enzyme catalase and methemoglobin, as suggested by comparison of the absorption spectra and hematin side-chains of these two substances, makes the determination of the molecular weight of catalase of considerable interest. Recently Stern and Wyckoff[2] concentrated horse catalase of a purity of 4,000 to 9,000 *Kat.f.* by sedimentation in an air-driven high-speed centrifuge and obtained a product with a *Kat.f.* of from 8,500 to 33,400. The sedimentation constant of this material they found to be 11×10^{-13}, indicating a molecular weight of 250,000 to 300,000. They obtained a sedimentation constant of 12×10^{-13} for a nearly pure catalase preparation from beef liver, but do not tell how this catalase was prepared.

The method of Sumner and Dounce[3] for preparing crystalline catalase from beef liver has made it easy to obtain this enzyme in what is apparently pure condition. We have prepared the enzyme in this laboratory and have determined the sedimentation constant of the recrystallized material by centrifuging an approximately 1 per cent. solution at 65,000 r.p.m. The value obtained over a pH range of 6.3 to 9.6 was 12.0×10^{-13}. A complete description of the method employed will be given in a later publication. Here, it suffices to note that the catalase was found to be a homogeneous substance, very slightly contaminated by impurity. Qualitative tests after centrifuging in a separation cell[4] showed that there was no enzymatic activity found in the solution removed from the upper portion of the cell and that the activity followed the high-molecular colored substance. Determination of the diffusion constant gave a value of 4.1×10^{-7}, while the partial specific volume was found to be 0.73. From these data the molecular weight of beef liver catalase is calculated to be 263,000. This value is almost exactly 4-fold the molecular weight of horse hemoglobin.[5] Now the percentage of iron in catalase is one fourth of that of hemoglobin, and accordingly the number of iron atoms per molecule must be four in catalase as well as in hemoglobin.

In conclusion, we wish to express our thanks to Professor The Svedberg for the use of his laboratory and to the Guggenheim Foundation for generous financial assistance.

JAMES B. SUMNER
NILS GRALÉN

[1] From the Institute of Physical Chemistry University, Upsala, Sweden.

[2] K. G. Stern and R. W. G. Wyckoff, SCIENCE, 87: 18, 1938.

[3] J. B. Sumner and A. L. Dounce, *Jour. Biol. Chem.*, 121: 417, 1937.

[4] A. Tiselius, K. O. Pedersen and T. Svedberg, *Nature*, 140: 848, 1937.

[5] T. Svedberg, *Nature*, 139: 1051, 1937.

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